

REMARKS

Applicant has amended claims 1-13 to clarify the language therein. Applicant respectfully submits that these amendments to the claims are supported by the application as originally filed and do not contain any new matter and do not raise any new issues which would require further consideration and/or search. Therefore, the Final Office Action will be discussed in terms of the claims as amended.

The Examiner has rejected claims 1-13 under 35 USC 112, second paragraph, as being indefinite. In reply thereto, Applicant has amended claims 1-13 to clarify the language therein. In addition, the Examiner states that in all the independent claims there is no predetermined voltage means claimed. In reply thereto, Applicant respectfully submits that piezoelectric oscillators are not generally equipped with power sources. Generally, a user who uses a piezoelectric oscillator prepares a power source and the voltage from the power source is supplied to terminals of the piezoelectric oscillator. Accordingly, Applicant respectfully submits that a voltage means or source of voltage is inherent in Applicant's invention as claimed.

Still further, the Examiner states that there is no connection between the amplifier circuit and the piezoelectric vibrator. Applicant has amended the claims to clarify this interconnection. Also, the Examiner states that in claims 2 and 8, which cite a second switch circuit, again those claims cite no predetermined voltage means to connect a test upon. In reply thereto, Applicant respectfully submits that the power source means used for a test is a voltage supply source prepared by the user and is therefore inherent in Applicant's claims. Still further, in claims 3 and 4, the Examiner again states that there is no predetermined voltage means necessary for the test and Applicant in response again states that such a voltage source is inherent in Applicant's claims. As to claims 10 and 11, the Examiner states that there is no control means cited such that it is clear how the drive level of the piezoelectric vibrator is controlled. In reply thereto, the drive level is changed to control by means of changing the power source voltage that is supplied to the amplifier circuit and such a change in the output voltage is done by the user and in this way the drive level is controlled.

In addition, Applicant would first like to explain the "drive level" used in the specification. The "drive level" means the level of voltage, "level of drive", that is supplied between the input terminal and the output terminal of the piezo-vibrator that is under excitation. In addition, the resonance frequency depends upon excitation level, and excitation level

dependency refers to an influence caused by condition changes of the excitation level in the series resonance resistance of a piezo-vibrator; and the parameter thereof is established by way of defining the ratio of the serial resonance resistance between two excitation levels. For instance, when the series resonance resistance at a lower excitation level is Rr1, and the series resonance resistance at a relatively higher excitation level is Rr2, then the ratio is shown by Rr1/Rr2.

Accordingly, in order to obtain a piezo-oscillator that is superior in frequency stability and characteristic reproducibility, it is inevitable to examine the resonance frequency changes relative to the changes of excitation level of a piezo-vibrator, that is, to examine the so-called drive level dependency ("DLD characteristics"). For instance, when dust is on the surface of a piezoelectric plate of a piezo-vibrator, such a phenomenon would occur that, at a particular drive level, due to the Mass Loading Effect caused by dust, the piezo-vibrator oscillates at a frequency that differs from the original resonance frequency of the piezo-vibrator. Accordingly, it is necessary to check the reproducibility (Hysteresis) by way of raising and lowering the drive level of the piezo-vibrator; and if a problem with the reproducibility (Hysteresis) of frequency is found, then the drive level needs to be raised up to a high level as it would not ruin the piezo-vibrator, thus intensely exciting the piezo-vibrator, letting the dust fly to be removed, stabilizing the resonance frequency and then obtaining the characteristic reproducibility.

If a piezo-vibrator is installed in a piezo-oscillator before the DLD characteristics of the piezo-vibrator is checked, in a case of the prior art piezo-oscillator shown in Fig 5(b) of the present application, it is not possible to check the resonance frequency by way of changing the excitation level. This is because such a prior art piezo-oscillator is designed so that the constant-voltage circuit 105 is installed so as to apply a constant voltage between the input terminal and the output terminal of the piezo-vibrator 102 and that the voltage supplied from the power source voltage Vcc is controlled by the constant-voltage circuit 105 so as to apply a constant voltage to the piezo-vibrator, allowing the piezo-vibrator to vibrate in a constant fashion.

The present invention, therefore, was made in light of the above-described problem with the prior art piezo-oscillator in which the drive level is controlled so as to remain at a constant value and thus the drive level for the piezo-vibrator cannot be changed.

In view of the above, therefore, Applicant respectfully submits that claims 1-13 comply with 35 USC 112, second paragraph.

The Examiner has rejected claims 1, 3, 5, and 7 under 35 USC 102 as being anticipated by Kato, stating that Kato shows a piezo-oscillator circuit comprising an oscillator circuit 2 and an amplifier circuit 1 and a constant-voltage circuit in which a power source Vcc and said oscillator circuit 2 are connected through said constant-voltage circuit to supply a constant-voltage to said oscillator circuit 2.

In reply thereto, Applicant would like to first point out the particular construction and operation of Applicant's invention. In particular, and as shown in Figs. 1 and 2, a switch circuit 4 is provided in the piezo-oscillator; and when the voltage to be supplied from the power source (the "power source voltage"), with the function of the control circuit 6, the switch circuit 4 selects the voltage Vcc, thus invalidating the constant-voltage circuit; or by way of providing the constant-voltage circuit 8 and the resistors R5 in parallel and also providing the switch circuit 5, when the power source voltage exceeds the predetermined value, with the function of the control circuit 6, the switch circuit 5 selects the resistor R5, thus invalidating the constant-voltage 8. With this structure, in the present invention, the voltage supplied from the voltage Vcc is directly supplied to the oscillator circuit 1 via the amplifier circuit 2. As a result, it is possible to vary the drive level applied to both ends of the piezo-vibrator; and by way of measuring the changes of resonance frequency of the piezo-vibrator relative to the changes in the excitation level, it is possible to check the DLD characteristics of the piezo-vibrator Y1. Thus, the frequency stability and the characteristic reproducibility are both obtainable.

On the other hand, the embodiment shown in Figs. 3 and 4, with the voltage supplied to the frequency control voltage section, the switch circuit 4 and the switch circuit 5 are controlled. Accordingly, the value of the power source voltage Vcc is irrelevant, the function of the constant-voltage circuit 3 or the constant-current circuit 8 can be invalidated. As a result, the power source voltage Vcc can be set to arbitrary values, and thus it becomes possible to control the drive level to a great extent. For instance, it is possible to test the reproducibility (Hysteresis) of the frequency changes in the piezo-vibrator by way of raising and lowering the voltage in the vicinity of the operation voltage Vcc. If the reproducibility (Hysteresis) has problems, then the piezo-vibrator is intensely excited (over driven) at a higher level than the operation voltage Vcc, thus getting rid of dusts from the piezoelectric plate and securing the frequency stability and the characteristic reproducibility.

Accordingly, in the present invention, with the use of the switch circuit, the constant-voltage circuit and the constant-current circuit are bypassed; and thus, even in a completed (assembled) piezo-oscillator, the DLD characteristics can still be checked.

Applicant has further carefully reviewed Kato and respectfully submits that in Fig. 1 of Kato, when the power source voltage V_{cc} is changed, the voltage at both ends (between the base of the transistor TR1 and the earth where the zener diode AD is grounded) of the zener diode ZD provided in the buffer amplification output circuit 1 is kept at a constant value V_z by the zener voltage that is decided by the characteristic of the zener diode. Since the base potential of the transistor TR1 becomes constant at V_z , the current that flows from the collector to the emitter of the transistor TR1 becomes consistent, and the voltage between the V_{cc} and the emitter of the transistor TR1 becomes also constant. At this point, the current inputted into the collector of the transistor TR2 of the piezo-oscillator circuit 2 becomes constant; however, though the V_{cc} changes, the voltage between the V_{cc} and the emitter of the transistor TR1 becomes constant as described above; as a result, the voltage between the collector of the transistor TR2 and the earth where the coil L2 is grounded changes.

In other words, the constant-voltage circuit of Kato that is comprised of the zener diode provided in the buffer amplification circuit 2 does not function as a constant voltage source for the piezo-oscillator circuit 2 but functions as a constant current source. Accordingly, as the power source voltage V_{cc} changes, the voltage between the collector of the transistor TR2 and the earth where the coil L2 is grounded also changes; however, the current inputted to the collector of the transistor TR2 become constant at a value i ; as a result, the current that flows to the piezo-oscillator circuit 2 becomes constant, resulting in that the drive level of the crystal vibrator X is kept at a constant value.

The Examiner says, "in Kato, when a voltage of the power source is equal to or higher than a predetermined value, a function of the constant-voltage circuit is invalidated." In view of this Examiner's comment, the Examiner seems to consider that the piezo-oscillator circuit 2 is applied with voltage that is larger than the constant voltage so as to overdrive the crystal vibrator X, thus realizing its intense excitation. However, as described above, when the V_{cc} is raised, the voltage between the collector of the transistor TR2 and the earth where the coil L2 is grounded would change, but the current inputted into the collector of the transistor TR2 becomes constant at the value i . Accordingly, the drive level of the crystal vibrator X becomes constant, and in the

piezo-oscillator of Kato, it becomes impossible to apply an overdrive to the crystal vibrator X. Therefore, the Examiner's view of Kato is incorrect.

On the other hand, in the present invention, by way of switching the first switch circuit or the second switch circuit, it is possible to avoid (bypass) the constant-voltage circuit 3 and the constant current circuit 8. As a result, the drive level that is applied to the piezo-vibrator can be controlled.

As seen from the above, Kato cannot provide the function and advantages of the piezo-oscillator of the present invention in which by way of changing the drive level for the piezo-vibrator so as to oscillate it, the changes in the resonance frequency are measured and the DLD characteristics of the piezo-vibrator are examined.

In view of the above, therefore, Applicant respectfully submits that Kato does not show each and every element of Applicant's claims and claims 1, 3, 5 and 7 are not anticipated thereby.

The Examiner has rejected claim 2 under 35 USC 102 as being anticipated by Gray, stating that Gray shows in Fig. 2 a piezoelectric oscillator comprising a piezo-oscillator including a piezo-vibrator 2, an amplifier circuit 31 and a constant-current circuit 21, 22 and a power source 14.

In reply thereto, Applicant would like to incorporate by reference his comments above concerning Applicant's invention. In addition, Applicant has carefully reviewed Gray and respectfully submits that the object of Gray is that in an oscillator that uses a crystal vibrator that activates at a series resonance frequency, so as to maintain the phase shift by an amplifier, an amplification circuit that provides a feed back voltage (DC) and a crystal vibrator are combined so as to provide a highly stable oscillator. Furthermore, it is another object of Kato to provide a highly stable oscillator for a timepiece that uses an inexpensive crystal vibrator with high precision and low voltage and current input.

As the Examiner points out, Fig. 2 of Gray shows a piezo-oscillator that is comprised of a piezo-oscillator including a piezo-vibrator 2, an amplifier circuit 31 and constant-current circuits 21 and 22. However, Gray describes, beginning to end, how to oscillate stably a piezo-vibrator at a constant frequency; and it merely corresponds to the piezo-oscillator shown in Fig. 5(b) of the present application. It is impossible in Gray to measure the changes in the resonance

frequency of a piezo-vibrator relative to the changes in the excitation level by way of changing the excitation level for the piezo-vibrator combined in a piezo-oscillator.

To the contrary, in the present invention, the power source line 7 and the constant-voltage circuit 8 are connected via the switch circuit 5, and the constant-current circuit 8 is connected in parallel to the resistor R5; and when the voltage supplied from the power source Vcc exceeds the predetermined value, the control circuit 6 controls the switch circuit 5 so as to connect the power source line 7 and the resistor R5, thus invalidating the constant-current circuit 8 and changing the drive level for the piezo-vibrator Y1. In Gray, this feature of the present invention is not at all disclosed or suggested. Furthermore, as to the issue and recognition of an issue of how, after assembling the piezo-vibrator Y1 into the piezo-oscillator, the fact that the piezo-vibrator Y1 is excited by way of changing the excitation level and the fact that the piezo-vibrator Y1 is excited at a constant voltage during the normal operation are balanced out is not at all disclosed or suggested.

Accordingly, Gray cannot provide the function and advantages of the piezo-oscillator of the present invention in which by way of changing the excitation level for the piezo-vibrator so as to oscillate it, the changes in the resonance frequency are measured and the DLD characteristics of the piezo-vibrator are examined.

In view of the above, therefore, Applicant respectfully submits that Gray does not disclose each and every element of Applicant's invention and claim 2 is not anticipated thereby.

Applicant further respectfully and retroactively requests a one month extension of time to respond to the Final Office Action. Please charge Deposit Account 11-1445 in the sum of \$110.00 as the fee.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

In view of the above, therefore, it is respectfully requested that this Rule 116 Amendment be entered, favorably considered and the case passed to issue.

SEP. 3. 2002 9:48AM

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NO. 578 P. 12

Please charge any additional costs incurred by or in order to implement this Amendment
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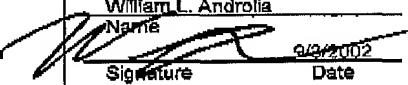
Respectfully submitted,

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